AIRS/AMSU/HSB Version 4.0 Level 2 QA Quick Start

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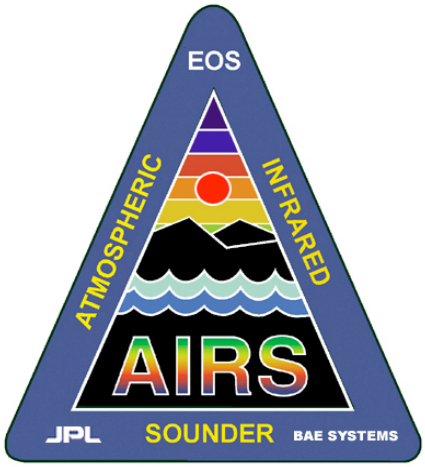

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Introduction

All AIRS Data Products are released, even those which are not as yet validated or are considered substandard. In the V3.0 data release, users were advised that the best practice for selecting data products to be included in scientific analyses is to require the fields-of-view to pass the **RetQAFlag = 0** filter. This "all or nothing" option is still available to the casual user of AIRS Data Products in the V4.0 data release and allows selection of the highest quality retrievals in the AIRS Level 2 Data Products. If you fit in this category of user, you can forego reading further and simply refer to the single page document:

V4.0_RetQAFlag.pdf

V4.0 introduces a set of product-specific quality flags that can be used to select valid Level 2 geophysical data products that would otherwise be filtered out by the use of the **RetQAFlag** test. This document provides a quick start identification of the quality flags that may be used to choose data for analysis.

The AIRS retrieval system provides three Level 2 products:

- L2 Standard Product
- L2 Support Product
- L2 Cloud-Cleared Radiance Product

Users are encouraged to use the Standard Product and Cloud-Cleared Radiance Product in their research.

The Support Product is intended for the knowledgeable, experienced user of AIRS products. It contains high resolution profiles intended to be used for computation of radiances, as-yet unimplemented research products and various parameters and intermediate results used to evaluate and track the progress of the retrieval algorithm. In particular, partial retrievals may fill support product fields with values that at first glance appear to be physically meaningful. However, these quantities are often intermediate results from various stages of the retrieval algorithm, are not physically meaningful and are used by the developers to improve algorithm performance for future deliveries.

In all products, the user must ignore fields that are filled with the invalid values:

- -9999 for floating-point numbers and 16-bit and 32-bit integers
- -1 or 255 for 8-bit fields

Please note that the field, **retrieval_type**, should not be used to select data for research. That field now indicates which path was taken through the retrieval algorithm and does not necessarily indicate the quality of the retrieval. A zero value simply indicates that the infrared radiances were employed.

RetQAFlag

The main quality indicator for all Level 2 products is the swath data field, **RetQAFlag**, which is present in all Level 2 Product Files. The casual user can create a subset of FOVs for analysis by selecting only those in which **RetQAFlag** = 0 (i.e., all bits of this 16-bit integer are set to zero). FOVs passing this test will be the highest quality retrievals and within the class of record type which have been validated. The yield of FOVs surviving this test will be greatly reduced. Users may find it easier to check the individual flags than to parse the bits of RetQAFlag to achieve a higher yield if their research does not require all retrieved parameters to be acceptable from TOA to surface.

The following table defines the bits of **RetQAFlag**. Definition of bits 0 – 4 remains identical to V3.0; definition of higher bits is changed or new in V4.0.

Bit 15	Spare, set to zero
Bit 14	Ozone retrieval rejected (**Qual_Ozone** > 0) or not attempted.
Bit 13	Water vapor retrieval rejected (**Qual_H2O** > 0) or not attempted. we are working on it; users are advised to proceed with caution..
Bit 12	Top part of temperature profile quality check failed (**Qual_Temp_Profile_Top** > 0) or not attempted. (above **Press_mid_top_bndry** mbar, indices **nStd_mid_top_bndry** and **nSup_mid_top_bndry**; see **Qual_Temp_Profile_Top** for details)
Bit 11	Middle part of temperature profile quality check failed (**Qual_Temp_Profile_Mid** > 0) or not attempted. (between **Press_bot_mid_bndry** and **Press_top_mid_bndry** mbar, indices **nStd_bot_mid_bndry**, **nSup_bot_mid_bndry**, **nStd_bot_mid_bndry**, and **nSup_bot_mid_bndry**; See **Qual_Temp_Profile_Mid** for details)
Bit 10	Bottom part of temperature profile quality check failed (**Qual_Temp_Profile_Bot** > 0) or not attempted. (below **Press_bot_mid_bndry** mbar, indices **nStd_bot_mid_bndry** and **nSup_bot_mid_bndry**; **Qual_Temp_Profile_Bot** for details)
Bit 9	Surface retrieval is suspect (**Qual_Surf** > 0)or rejected.
Bit 8	This record type not yet validated
Bits 6-7	Spare, set to zero
Bit 5	Cloud/OLR retrieval rejected or not attempted
Bit 4	Final retrieval rejected or not attempted
Bit 3	Final Cloud Clearing rejected or not attempted
Bit 2	Initial Regression rejected or not attempted
Bit 1	Initial Cloud Clearing rejected or not attempted;
Bit 0	MW retrieval rejected or not attempted

Table 1. RetQAFlag with new bits defined

New Quality Control Flags for Retrieved Geophysical Quantities

In this release, a set of quality flags, **Qual_***, has been provided to inform the user separately about the quality of the retrieval of various products, and the retrieved temperature in three altitude regimes. The user who carefully employs these flags will substantially increase the sample size of various retrieved parameters.

Qual_MW_Only_Temp_Strat	Overall quality flag for MW-Only temperature fields for altitudes above 201 mbar
Qual_MW_Only_Temp_Tropo	Overall quality flag for MW-Only temperature fields for altitudes at and below 201 mbar, including surface temperature.
Qual_MW_Only_H2O	Overall quality flag for MW-Only water (both vapor and liquid) fields. The possible values this flag are **0** (H2O retrieval fully valid), **1** (only total precipitable water vapor is valid), **2** (H2O invalid); we are working on it; users are advised to proceed with caution
Qual_Cloud_OLR	Overall quality flag for cloud parameters and clear and cloudy OLR
Qual_H2O	Overall quality flag for water vapor fields
Qual_CO	Quality flag for CO
Qual_O3	Quality flag for ozone
Qual_Temp_Profile_Top	Quality flag for temperature profile at and above **Press_mid_top_bndry** mbar (currently 200 mb)
Qual_Temp_Profile_Mid	Quality flag for temperature profile below **Press_mid_top_bndry** mbar and above **Press_bot_mid_bndry** mbar (currently 3 km above surface)
Qual_Temp_Profile_Bot	Quality flag for temperature profile at and below **Press_bot_mid_bndry** mbar, including surface air temperature
Qual_Surf	Overall quality flag for surface fields including surface temperature, emissivity, and reflectivity
Qual_CC_Rad	Overall quality flag for cloud cleared radiances
Qual_Guess_PSurf	Quality flag for surface surface pressure guess input. The possible values are **0** (good surface pressure guess from valid forecast), **1** (surface pressure guess estimated from topography), and **2** (do not use)

Table 2. New Quality Control Flags for Retrieved Geophysical Quantities

Discussion of Quality Flags for Level 2 Physical Products

The possible values of the above flags are 0, 1 and 2.

- 0 indicates that the corresponding retrieved parameters are of best quality and can be used in validation statistics as well as level 3 processing.
- 1 indicates that the corresponding retrieved parameters are of good quality to be used in level 3 processing but not in validation statistics.
- 2 indicates that the corresponding retrieved parameters are of poor quality and hence should not be used in subsequent data analysis.

Some of the flags are not given the value of 1 in this version.

The boundaries between regions governed by quality flags are specified as pressures. These pressures may not be exactly equal to the pressures in the standard or support pressure arrays. For example, the user may be uncertain as to whether the quality flag attributed to a layer/level product array element might be **Qual_Temp_Profile_Mid** or **Qual_Temp_Profile_Bot**.

The quality of profiles is determined from the top of the atmosphere downward, i.e. from low pressure to high pressure. For a level quantity like temperature or a layer quantity like water vapor, the appropriate quality flag is **Qual_Temp_Profile_Mid** only if the pressure of the level on which the quantity is reported is **less than** **Press_bot_mid_bndry**. Confusion can arise when a layer spans a pressure boundary. The appropriate quality flag is **Qual_Temp_Profile_Bot** if the pressure of the level on which water vapor is reported is **equal to or greater than** **Press_bot_mid_bndry** despite the fact that the pressure of the level above is less than **Press_bot_mid_bndry**.

The Standard Product also contains level numbers, **nStd_mid_top_bndry** and **nStd_bot_mid_bndry**, which are the indices of the standard pressure levels (1's based numbering, 1 through 28, pressures decrease with increasing index) whose pressures are **nearest to** **Press_mid_top_bndry** and **Press_bot_mid_bndry** respectively. Users are urged not to make use of these level indices as boundaries between quality flag regimes. The boundaries are determined by pressure. These indices are a starting point to allow the user to determine whether the levels so identified are above or below the corresponding boundary pressures and to choose those indices (or the neighboring ones at lower pressure) as the proper indices for the boundaries.

The same cautions apply to the Support Product, where **nSup_mid_top_bndry** and **nSup_bot_mid_bndry** are indices of the support pressure levels (1's based numbering, 1 through 100), and the pressure increases with index.

All profile entries for pressures greater than **Press_valid_botttom** are invalid.

Qual_Surf

Overall quality flag for surface fields including surface temperature, emissivity and reflectivity

- 0 or 1 occurs in 20% of all retrievals over water
- 1 occurs in 67% of all retrievals over land

The criteria for Qual_Surf = 0 are the most stringent of all the new quality flags, and the yield should be nearly identical to that resulting by requiring RetQAFlag = 0.

Qual_Guess_PSurf

Quality flag for surface pressure guess input.

- 0 signifies good surface pressure guess from valid forecast
- 1 signifies surface pressure guess estimated from topography
- 2 signifies that it should not be used

This quality flag is practically always 0. It will assume a value of 1 only if the retrieval was run without the NCEP forecast input.

Qual_MW_Only_Temp_Strat

Overall quality flag for MW-only temperature fields for pressure levels less than **Press_mid_top_bndry**.
This quality flag is 0 for approximately 95% of all retrievals.

Qual_MW_Only_Temp_Tropo

Overall quality flag for MW-only temperature fields for pressure levels greater than or equal to **Press_mid_top_bndry**, including surface temperature. . Profile entries for pressures greater than **Press_valid_botttom** are invalid.
This quality flag is 0 for approximately 94% of all retrievals

Qual_MW_Only_H2O

Overall quality flag for MW-only water (both vapor and liquid). Profile entries for pressures greater than **Press_valid_botttom** are invalid.

- 0 signifies H2O retrievals fully valid (86% of retrievals in Collection 4, i.e., if HSB data are included)
- 1 signifies only total precipitable water vapor is valid (0% of retrievals in Collection 4, i.e., if HSB data are included)
- 2 signifies H2O retrievals invalid (14% of retrievals in Collection 4, i.e., if HSB data are included)

In Collection 3 (no HSB data available), this flag assumes values of 1 (mostly over water) or 2.

Qual_H2O

Overall quality flag for water vapor fields. we are working on it; users are advised to proceed with caution. Profile entries for pressures greater than **Press_valid_botttom** are invalid.

- 0 signifies water vapor retrievals valid (87% of retrievals over water; 83% of retrievals over land)
- 1 never occurs
- 2 signifies water vapor retrievals invalid

Filtering via this quality flag yields wet bias in presence of stratocumulus. Use **Qual_Temp_Profile_Mid** as filter if working with total water burden in fields affected by stratocumulus. On the other hand, applying **Qual_Temp_Profile_*** flags throughout will result in a dry bias.

Qual_CO

Overall quality flag for CO research product. **IGNORE, under development.**

Qual_O3

Overall quality flag for ozone fields. Useful filter for total burden of ozone over tropical and mid-latitude ocean and land. **Do not believe Qual_O3 = 0 over snow and ice and desert.**

- 0 signifies ozone retrievals valid (87% of retrievals over water; 83% of retrievals over land)
- 1 never occurs
- 2 signifies ozone retrievals invalid

Qual_Temp_Profile_Top

Quality flag for temperature profile at and above **Press_mid_top_bndry** (200 mb)

- 0 signifies temperature profile in this pressure regime valid (88% of retrievals over water; 86% of retrievals over land)
- 1 never occurs
- 2 signifies temperature profile in this pressure regime invalid

Qual_Temp_Profile_Mid

Quality flag for temperature profile between Press_mid_top_bndry (200 mb) and Press_bot_mid_bndry (3 km above surface)

- 0 signifies temperature profile in this pressure regime valid (58% of retrievals over water; 68% of retrievals over land)
- 1 never occurs
- 2 signifies temperature profile in this pressure regime invalid

This flag appears to eliminate known problems in stratocumulus regions, but may decrease yield in midlatitude storm tracks (esp. in Southern Hemisphere).

Qual_Temp_Profile_Bot

Quality flag for temperature profile below **Press_mid_top_bndry** (3 km above surface). Profile entries for pressures greater than **Press_valid_botttom** are invalid.

- 0 signifies temperature profile in this pressure regime valid (45% of retrievals over water; 20% of retrievals over land)
- 1 signifies temperature profile in this pressure regime, good enough for Level 3 but not for validation statistics (13% of retrievals over water; 47% of retrievals over land)
- 2 signifies temperature profile in this pressure regime invalid

Qual_Cloud_OLR

Overall quality flag for cloud parameters and clear and cloudy outgoing longwave radiation. Retrieval of cloud parameters and OLR is attempted even in the event that the MW algorithm rejects the retrieval.

- 0 occurs when full combined MW/IR retrieval is performed (**retrieval_type** = 0)
- 1 occurs when MW algorithm rejects the retrieval
- 2 rarely occurs

Qual_CO2

Overall quality flag for future CO2 research product (in Support Product).
IGNORE, under development and in Version 4 release the CO2 is climatology.

Qual_CH4

Overall quality flag for future CH4 research product (in Support Product).
IGNORE, under development and in Version 4 release the CH4 is climatology.

Cloud-Cleared Radiances Quality Checks

Qual_CC_Rad

- 0 signifies highest quality
- 1 signifies good quality
- 2 signifies Do Not Use

The quality flag, **Qual_CC_Rad,** should be used as the main quality indicator in the Level 2 Cloud Cleared Radiance Product. The accuracy of the radiances in the cloud-cleared radiance product varies from channel to channel with the properties of the individual detectors. Some AIRS detector will have properties that will rule out their use for some purposes. Radiances are set to -9999 for detectors of lowest quality. Casual users can just check for -9999 as radiance values. The casual user will find this quality easiest to use.

There is a set of dynamic flags and a set of static flags for each channel for cloud cleared radiance product. The static properties of each of the 2378 AIRS IR channels are summarized in a series of "**channel properties files**" keyed by effective start date.

Users of AIRS L2 Cloud-Cleared radiances will find it profitable to select channels whose entries in the appropriate channel properties file satisfy these criteria at a minimum:

Criterion	column	required value
AB_State	11	0, 1 or 2
Radiometric quality	12	0
L2_ignore*	13	0

Table 3. Static Channel Property File

*L2_Ignore includes additional information about SRF incompatibility with the AIRS transmission model. Users of this model or other similar models should avoid all channels where L2_ignore is nonzero. Other users of L1B radiances may ignore this flag entirely.

The dynamic calibration flags, **CalFlag**, **CalScanSummary**, **CalChanSummary** and **ExcludedChans**, are copied to the cloud cleared radiance product files, as well as dynamic estimated noise **NeN**. Please refer to

L1B_QA_Quick_Start.pdf

for a discussion and definition of the above flags.

Quick Start QA for VIS/NIR L2 Data

Per-Field-of-View Quality Checks

The following QA flags are contained in the L2 Support Product, and should be checked for a value of 0 (zero), indicating that the relevant products are valid. Each of these QA flags is at AMSU resolution:

- **bad_vis_cld_de**

  Set to 1 when a problem was encountered in the cloud detection algorithm
- **bad_vis_cld_hgt**

  Set to 1 when a problem was encountered in the cloud height algorithm. Note, however, that no cloud height products have been validated, and the user is advised to ignore these fields regardless of the flag value

Advanced Quality Checks

The following QA flags are contained in the L2 Support product, and should be checked for a value of 0 (zero), indicating that the relevant products are valid. Each of these QA flags is at AMSU resolution:

- **vis_glint**

  When set to 1, sun-glint may be affecting the reported Vis/NIR radiances and products